risks of investing in a fully addressable system at this stage of its technological development.[31]

Even in partially addressable systems, the costs to implement the tier buy-through prohibition are significant. Time Warner estimates that the cost of providing additional addressable descrambler boxes alone in order to comply with the anti buy-through requirements would be in excess of $400 million. This cost estimate is arrived at as follows: Time Warner estimates that it has 6,173,593 subscribers in systems with potential addressability and that 2,755,054 of those subscribers currently have been provided with addressable descramblers. Assuming that 10% of all subscribers (617,359) elect to purchase only the regulated basic service tier and won't need a descrambler box, this would still require such boxes be given to the remaining 2,801,180 subscribers. In addition, 840,354 additional addressable boxes would be needed if an industry average of 30% additional outlets is assumed. At a conservative cost of $110 per addressable box with 3,641,534 addressable boxes required, Time Warner's cost would be over $400 million. This estimate does not include other costs such as installation and administrative costs, and it assumes that no basic-only customers would exercise their rights under the buy-through provision.

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[31]The risks of committing to the current technology include obsolescence of current scrambling technology, supply of set-top converters is limited and increasing supply would likely reduce quality and reliability of converters produced, and future set-top features to be developed to increase the compatibility of cable service and consumer electronics could not be deployed.

The only other option to removing traps would be to reconfigure the channel lineup and trapping scheme to retain trapping but still allow access to premium services. This is not a viable option either for non-addressable or partially addressable systems for several reasons. Initially, if the cable operator reconfigures the channel lineup and groups the premium channels immediately above the basic tier, new traps would have to be installed to protect premium channels that are not requested. Because a maximum of three traps may be installed before the cable drop becomes too unwieldy, it may not be possible to arrange traps for every subscriber request or make available all premium services offered by the cable system.

Another problem arises from the fact that the basic service tier trap would have to be configured to include all local must-carry and premium channels. Both of these categories of channels, however, are subject to change. New broadcast stations and premium services may become available at any time. This is exacerbated further by the fact that the statute apparently allows broadcast stations to change their must-carry/retrans-mission consent election every three years.[32] Because individual traps can not accommodate changes in the number of channels the trap is designed to pass without replacement of the trap itself, this makes it extremely difficult to design a trapping scheme for the basic tier. The likely result is that cable operators would be discouraged from adding discretionary services to the basic

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[32]*See* 47 U.S.C. §325(b)(3)(B).

level, from adding new a la carte premium services, and perhaps even forcing deletion of existing services to avoid repeated channel reconfiguration and the need to constantly replace expensive basic service traps.[33]

Finally, grouping premium channels adjacent to the basic service tier would still not allow basic-only subscribers access to pay-per-view channels in most instances since, unlike premium channels, it is not feasible to use traps to secure pay-per-view programming.[34] As the foregoing demonstrates, the cost and disruptive effect of satisfying the basic subscriber's request for premium or pay-per-view channels under a non-addressable or partially addressable system are not at all similar to the minimal costs and a simple coded entry on a computer terminal that would be required to meet those requests in a fully addressable system.

3. Compliance is impossible where full addressability has not been deployed system-wide.

The Commission seeks comment on how "the buy-through provisions operate in instances in which only one community among several served by the same cable system has addressable capability."[35] Time Warner submits that such partially addressable systems should also fall within the protection of the

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[33]Note, however, that one of the purposes of the 1992 Cable Act is to increase the diversity of programming. 1992 Cable Act, §§2(a)(6) & 2(b)(3); 47 U.S.C. §547(a).

[34]As noted *supra*, the use of addressable traps does overcome this one technical drawback by allowing the trap to be bypassed from the system headend.

[35]Notice at ¶5.

ten-year grace period for compliance. Partially addressable systems are those where addressable technology has been implemented in only a portion of the system's service area. In such cases, the tier buy-through prohibition should not apply because compliance would result in raising cable rates and/or would violate other provisions of the 1992 Cable Act.

Initially, the Notice specifically requests comment on whether the buy-through provision should apply to portions of cable systems where compliance would be possible when those systems are in the process of modifying their security system.[36] Time Warner submits that requiring compliance in portions of cable systems would be inconsistent with the language of the buy-through prohibition. The ten-year transition period expressly applies to any "cable system" that cannot comply.[37] If a partially addressable cable system cannot provide all basic subscribers with pay and pay-per-view programming on a non-discriminatory basis, then that cable system is unable to comply. The opposite conclusion, that cable systems must comply with the prohibition to the extent that each subscriber receives addressability, could place a cable operator in violation of the

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[36]Notice at ¶6.

[37]47 U.S.C. §543(b)(8)(B).

nominal downgrade charge provision of the 1992 Cable Act.[38] Given the fact that Congress chose the cable system, and not the subscriber, as proper measure of whether the tier buy-through prohibition could be complied with, the prohibition can not take effect until the entire system becomes addressable as to all non-basic channels. Certainly there is no indication that Congress intended to penalize all cable systems in transition from non-addressable to addressable technology with two sets of rate regulation rules to follow -- one for addressable customers and another for non-addressable customers.[39]

C. Cable operators should not be required to compromise security against theft to comply with anti buy-through.

As the Commission considers regulations to implement the anti buy-through provisions, an overriding goal should be to avoid mandating any actions which are likely to increase the incidence of theft of cable service. Implementation of a security system to protect from signal theft is a vital component of any cable system in the United States today. A recent survey by the National Cable Television Association estimates that the

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[38]Assume that a cable system plant is fully addressable in a portion of the franchise area, and non-addressable in the remainder. Section 623(6)(5)(C) requires that downgrade charges be "nominal" in the addressable portion of the system and be "based on the cost of such change" in the non-addressable portion. As noted above, such costs can be significant for non-addressable plant since a truck roll is required. This situation could potentially place the operator in jeopardy under Section 623(d) of the Act.

[39]As noted *infra*, Time Warner does not believe that deliberate reconfiguration of a cable system for the sole purpose of evading the tier buy-through prohibitions should be tolerated by the FCC under the ten-year exception.

cable industry lost approximately $4.7 billion of revenues in 1991 due to cable theft.[40] The study found that the average percentage of theft was 11.21 of basic service (including tiers) and 11.52 percent of premium service.[41]

Congress has recognized the serious threat that theft poses to the cable television industry and has enacted both civil and criminal federal penalties against it.[42] The legislative history of the cable theft provision of the 1984 Cable Act reveals that Congress was deeply concerned about this problem:

> The theft of service is depriving the cable industry of millions of dollars of revenue each year which it would otherwise be receiving. The Committee believes that theft of cable service poses a major threat to the economic viability of cable operators and cable programmers, and creates unfair burdens on cable subscribers who are forced to subsidize the benefits that other individuals are getting by receiving cable service without paying for it.[43]

Congress' continuing concern for cable theft is evident in the 1992 Cable Act which strengthened existing penalty provisions.[44]

Cable operators should not be required to take actions that might promote theft of cable service in order to comply with the tier buy-through prohibitions. Although non-addressable and partially addressable systems are not able to provide basic

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[40]*Cable Theft Reaches Record High Figure*, Communications Daily, Special Western Show Edition, December 3, 1992, at 11.

[41]*Id.*

[42]47 U.S.C. §553.

[43]H.R. REP. No. 934. 98th Cong., 2d Sess. 83 (1984).

[44]1992 Cable Act, §21, *amending*, 47 U.S.C. §533(b).

subscribers with easy access to premium and pay-per-view channels, these systems should not be forced to unscramble their signals without proper security devices that protect the cable operator from cable theft. Since signal security is so critical to any cable television system, FCC rules should not force non-addressable or partially addressable systems to provide access to basic subscribers where the cable operator cannot protect its entire signal from theft.

Indeed, even the scrambling technologies utilized by fully addressable systems today are quickly becoming obsolete. Although the pace of industrywide conversion to addressability has heretofore allowed equipment manufacturers and cable operators to stay ahead of video pirates, an accelerated roll out of addressability on a wide scale could tip the balance in favor of the pirates. A premature widespread conversion to full addressability creates a natural market incentive to encourage signal pirates in their efforts to defeat current encryption technologies and either manufacture illegal decoders or alter existing boxes to circumvent addressability. To avoid this, the Commission should only apply the anti buy-through provisions to those situations where a system currently has the technology completely in place to comply with the statutory requirement.

D. The Commission should not prematurely force cable systems to implement obsolete or unproven technology to accommodate anti buy-through.

Time Warner estimates that approximately 7-10% of its subscribers currently are served by fully addressable cable

systems. That number will grow steadily as technology improves, costs come down, systems are rebuilt and new services are developed for which a la carte marketing is desirable.[45] Given the rapid technological advances that have occurred in such areas as digital transmission, signal compression, high definition television, video switching and the like, the Commission must not require systems which are not yet fully addressable to commit to any one particular scrambling or signal security approach merely to comply with anti buy-through prior to the end of the statutory transition period.

Time Warner urges the Commission not to implement the anti buy-through provisions of the statute in a manner that would lock cable operators into obsolete technologies or that would stifle the development of newly emerging technologies which show great promise for the future. For example, the Commission might be tempted to encourage cable operators to employ interdiction technology since such technology theoretically would allow the anti buy-through provisions of the statute to be implemented while at the same time allowing the consumer compatibility equipment goals of the statute to be accomplished. It should be noted, however, that while compliance with the tier buy-through

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[45]The maturation and development of the pay-per-view market, the integration of video and computer technologies, and the development of digital compression all represent natural marketplace incentives for increasing the deployment of technology that will allow implementation of the anti buy-through provisions of the statute.

prohibition through an interdiction system is possible, its use has a number of drawbacks.[46]

Interdiction technology is largely unproven and not widely used, though it has been on the market for over five years. Time Warner has experimented with the feasibility of interdiction technology in a test involving 200 homes in Williamsburg, Virginia. Unlike addressable descramblers, which are located inside the subscriber's premises, interdiction devices are placed at exterior locations. Time Warner has found that the electronic interdiction boxes are unacceptably sensitive to climate and weather changes and tend to be unreliable. This has diminished the quality of cable service and has caused significant consumer dissatisfaction. In addition, interdiction systems tend to add noise and interference as more channels are added to the system. With present interdiction system technology, these factors raise rates to the consumer yet are an unstable link in the cable system. Furthermore, interdiction systems are totally incompatible with newly developing digital technologies such as video compression. Time Warner believes digitization will allow the integration of computer, video and audio technologies to provide new services and technologies that are only just now being realized.[47] Clearly, the FCC should not mandate premature

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[46]See Appendix 1, "Off-Premises Broadband Addressability: A CATV Industry Challenge."

[47]The Commission also notes that some systems utilize "addressable taps." Notice at ¶2. The use of addressable taps is also generally considered to be obsolete; such devices also involve many of the same drawbacks as interdiction.

compliance with anti buy-through using present technologies that would delay or prevent these developments, but should allow marketplace forces to achieve that result during the statutory transition period.

Indeed, the Commission astutely expresses interest "in the implementation of digital compression technologies which can also be used to increase dramatically the number of channels on a cable system."[48] While rapid breakthroughs have been achieved in the development of digital compression, the current generation of addressable descramblers deployed by the cable industry are entirely incompatible with digital transmission. For this reason alone, Time Warner strongly urges the Commission not to require "new cable systems constructed during the 10-year period . . . to comply with the buy-through prohibition upon construction."[49] Such a requirement would require a massive deployment of potentially obsolete technology and inhibit advances such as digital compression and HDTV. Rather, all cable systems should be entitled to the full ten year grace period established by Congress to allow a natural evolution of technologies capable of compliance with anti buy-through.[50]

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[48]Notice at ¶4, n.4.

[49]Notice at ¶9.

[50]For this same reason, the Commission should decline promulgation of waiver guidelines at this time. *See* Notice at ¶9. Any guidelines adopted now will surely be obsolete as the end of the 10 year grace period approaches, given the explosive advances in cable television technology.

III. Evasions Of The Anti Buy-Through Provisions.

The 1992 Cable Act directs the FCC to establish rules to prevent "evasions" of its rate regulation provisions.[51] The Notice points out that the evasion question appears to focus on other rate issues being considered in a separate FCC proceeding, but nevertheless seeks comment on any issues which may be raised by the evasion provision of the 1992 Cable Act as they relate to the tier buy-through provisions.[52] Nothing in the statute or the legislative history provides any indication that Congress was attempting to restrict any specific practices which might constitute an "evasion" of the tier buy-through prohibition. Indeed, the question of whether Congress even intended the "evasion" prohibition to cover tier buy-through is complicated by consumer electronics compatibility goals of §17 of the 1992 Cable Act and Congress' apparent efforts to encourage the availability of non-basic channels on an a la carte basis. In determining whether any practices should be considered to be evasions of the tier buy-through restrictions, the FCC should be highly sensitive to these possibly conflicting policies.

Time Warner believes that, at most, only two circumstances should be considered as evasions of the anti buy-through provisions. First, if a cable operator deliberately reconfigures an existing fully addressable system solely in order to avoid the buy-through prohibition, this action should be deemed an evasion.

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[51]47 U.S.C. §543(h).

[52]Notice at ¶8, fn. 8.

Second, if a cable operator with a system which is not fully addressable throughout the system's service area deliberately stops or substantially delays its schedule of implementing full addressability for the sole reason of avoiding the anti buy-through prohibition, and contrary to a schedule for deployment of addressability as agreed to in a franchise, this should also be considered an evasion.

Beyond those narrow instances where an unmistakable intent to evade the anti buy-through provisions can be demonstrated, the Commission must be careful to refrain from defining conduct that is necessitated by legitimate regulatory and business considerations to be an evasion. For example, Section 17 of the 1992 Cable Act requires the FCC to promulgate rules to consider limits on the use of scrambling and encryption because such security methods may interfere with the consumer electronic features of VCRs and some television sets.[53] However, in order to comply with the tier buy-through requirement, a cable operator must deploy a fully addressable system which necessitates scrambling of all channels that are to be secured.[54]

The anti buy-through provision of the statute explicitly approves of the use of encrypted signals and descramblers by cable operators. These conflicting provisions must be resolved

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[53]47 U.S.C. §544.

[54]The use of an interdiction system might solve the conflict between consumer electronics compatibility and tier buy-through requirements. However, as discussed *infra* at Section II(D), due to the unstable nature of interdiction technology, it is not presently a feasible alternative.

in the FCC rulemaking process. In doing so, the FCC must make clear that a cable operator is not considered to evade the anti buy-through provisions by continuing to use non-addressable technology, such as trapping devices which minimize the use of scrambling, which are employed to comply with equipment compatibility requirements. Indeed, Congress apparently adopted the ten year grace period at least in part for the specific purpose of allowing a natural evolution of technology, with the hope that within that period new techniques might be developed which satisfy both the tier buy-through requirement and consumer electronics equipment compatibility goals of the 1992 Cable Act.

Similarly, it should be noted that franchise agreements often require a cable operator to secure signals in a manner that does not require the use of a descrambler or descrambler, where possible, in order to address consumer electronics compatibility concerns analogous to those raised by §17 of the 1992 Cable Act. The Commission must acknowledge that there is no evasion when the cable operator deploys unscrambled or partially scrambled cable programming services, or a non-addressable or partially addressable system in order to comply with its franchising requirements.

The Commission should also acknowledge that it is not an "evasion" for a cable operator to offer one or more video programming services on an a la carte basis, even if such services were formerly offered as part of a tier. One of the policy goals of the anti buy-through provision is to allow consumers to have greater choice and control over the programming

that they must pay for by encouraging the unbundling of cable programming.[55] The anti buy-through provision only prohibits mandatory buy-through of service tiers. As the D.C. Circuit Court of Appeals explained, "[c]able operators typically market their service by bundling an assortment of channels together and offering them as a group, or 'tier'".[56] Where services are offered on an a la carte basis, such as premium or pay-per-view services, they do not meet the definition of a service tier since they are not sold as a group for a single price.[57] Similarly, the Notice asks whether the anti buy-through provision permits "the offering of multiple, and perhaps overlapping, tiers on a noncumulative basis."[58] As noted above, Sec. 623(b)(8) of the

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[55]*See*, 138 Cong. Rec. S. 14608-09 (daily ed. Sept. 22, 1992) (statement of Sen. Inouye) ("The purpose of this provision is to increase options for consumers who do not wish to purchase upper cable tiers but who do wish to subscribe to premium or pay-per-view programming."); S. REP. No. 92, 102d Cong., 1st Sess. 77 (1991) ("greater unbundling of offerings leads to more subscriber choice and greater competition among program services."). *See also*, Notice at ¶3. While unbundling may be a goal that Congress wished to encourage, the tier buy-through prohibition does not require the unbundling of non-basic programming. Furthermore, unbundling is largely a speculative proposition. Unbundling raises problems of contractual relationships, billing, marketing, and consumer confusion. *See, Ops Not So Hot On A La Carte*, Multichannel News, December 21, 1992, at 31.

[56]American Civil Liberties Union v. FCC, 823 F.2d 1554, 1565, n.29 (D.C. Cir. 1987), cert. denied, 485 U.S. 959 (1988).

[57]The Notice states that basic tier subscribers are entitled to buy through to premium or pay-per-view service "without subscribing to intermediate services or tiers of service (e.g. tiers commonly known as "expanded basic")." Notice at ¶7. However, there is nothing in the tier buy-through provision that prohibits buy-throughs of "intermediate services," and the FCC should not expand the scope of the provision beyond buy-throughs of service tiers.

[58]Notice at ¶8.

Act only affects the availability of premium or pay-per-view services to basic-only subscribers, it does not affect marketing of expanded tiers, whether on a cumulative or noncumulative basis.

IV. The FCC Should Encourage Flexible Marketing Approaches As It Enforces The Rate Nondiscrimination Clause.

Section 623(b)(8)(A) of the Act provides that "[a] cable operator may not discriminate between subscribers to the basic service tier and other subscribers with regard to the rates charged for video programming offered on a per channel or per program basis." The Notice seeks comment on whether this nondiscrimination clause should be interpreted to mean "that basic subscribers who do 'buy through' [to premium services without purchasing intermediate services] are entitled to the same rate structure for those premium or pay-per-view services as subscribers purchasing intermediate services or tiers."[59] Time Warner agrees with this interpretation.

Discrimination under the tier buy-through prohibition should be narrowly defined as the imposition of a greater price for a specific premium channel or a specific pay-per-view programming event charged to a basic-only subscriber as compared to a non-basic subscriber in the same franchise area.[60] This definition addresses the concern that basic subscribers are not charged any

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[59]Notice at ¶7.

[60]This definition would be easy to enforce; the franchising authority or the Commission need only compare the rate charged for each service or group of specified services as between a basic-only subscriber and any other subscriber to that system in that franchise area.

more for the same premium channel or pay-per-view event - all subscribers are offered the same rate for these channels. However, this definition also does not require the cable operator to charge the same rate for different pay channels, events, or programming packages offered to the same subscriber.

The Commission must be careful not to adopt an overly broad definition of discrimination that would force cable operators to diminish marketing innovations and promotional discounts which would reduce the programming choices made available to subscribers.[61] Thus, a cable operator who offers discounts for the purchase of multiple premium service packages does not engage in discrimination so long as the same discounts are available to basic-only subscribers. Such package discounts reflect non-discriminatory economic incentives. As the subscriber adds premium or pay channels, the marginal utility for additional programming may diminish. The non-discrimination clause should not prevent the cable operator from providing additional premium channels at a reduced price to both basic-only and expanded tier subscribers which maximizes efficiency in the distribution of video programming. The same analysis would apply whether the cable operator offers a specific group of premium channels for a reduced price or whether it applies a discount for every second, third, etc. premium channel added by the subscriber. Using this analysis, the discounts suggested in paragraph 8, footnote 7 of

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[61]The Commission has long recognized that in the rapidly evolving video marketplace, operators must have the maximum flexibility in packaging their services. Community Cable TV, Inc., *supra*.

the Notice are non-discriminatory so long as basic subscribers can also take advantage of these discounts on the same basis as expanded tier subscribers.

The FCC's non-discrimination policies should not inhibit cable operators from offering a wide variety of nondiscriminatory choices and options when marketing their cable services. One consumer option that the Notice does not consider is that a subscriber may purchase only pay or pay-per-view channels without purchasing basic tier service. The Notice at paragraph 7 states; "the nondiscrimination provisions and the basic tier definition appear to work in tandem to mean that all cable subscribers will, at a minimum, purchase the basic tier." Time Warner strongly disagrees with this observation. Section 623(b)(7) of the statute states that basic service "is required for access to any other tier of service."[62] Those subscribers who do not want to buy through the basic service tier are not prevented under the 1992 Cable Act from purchasing only those services which the cable operator might choose to market on an a la carte basis, such as premium or pay-per-view channels. Indeed, the Notice states that "[t]he goal of the Act's buy-through prohibition is to foster the ability of subscribers to choose freely among available programming services."[63] Accordingly, cable operators

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[62]47 U.S.C. §543(b)(7)(A) (emphasis added).

[63]Notice at ¶3. Of course, pay-only subscribers are not protected under the nondiscrimination clause of the tier buy-through prohibition, as they cannot be considered basic-only subscribers. In addition, the tier buy-through provision does not prevent a cable operator from requiring all subscribers to buy through the basic service tier.

should have the ability, at their sole option, to offer premium or pay-per-view services without necessitating subscription to basic service. Similarly, the FCC rules should not restrict premium service promotional discounts for limited time periods as long as such discounts are available to all subscribers.

Enforcement of the buy-through prohibition should be accomplished by resolving disputes as they arise on a case-by-case basis. Since this provision is part of the basic tier rate regulation scheme of §623(b) of the Act, the implementation and enforcement provided for in that section of the 1992 Cable Act should apply.[64] Under this dispute resolution provision, enforcement by the FCC would be conducted by resolving the tier buy-through disputes that are brought before the Commission by franchising authorities or cable operators. This enforcement scheme leaves to the franchising authority the initial resolution of disputes, which reduces administrative burdens on the FCC.[65]

V. Conclusion

In sum, Time Warner urges the Commission to apply the ten year grace period to any system which would be required to incur more than nominal costs to comply. Generally speaking, only fully addressable systems which scramble all non-basic channels,

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[64]47 U.S.C. §543(b)(5)(B).

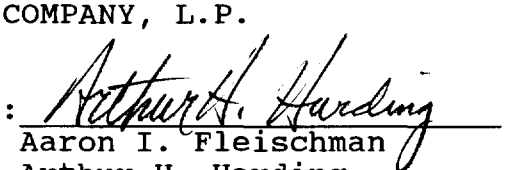
[65]The 1992 Cable Act directs the FCC to seek to reduce administrative burdens on the Commission. 47 U.S.C. §543(b)(2)(A). If the FCC were not involved in policing local cable rate structures but functioned to resolve disputes, as is suggested here, then the cost burdens, in terms of lawyers' fees, filing requirements, etc. would be reduced as well for franchising authorities and cable operators.

including expanded tiers, are technically capable of compliance. Moreover, cable operators should not be required to compromise security against theft in order to comply with anti buy-through. Similarly, the Commission should not prematurely force cable systems to implement obsolete or unproven technology to accommodate anti buy-through at the expense of technological advances such as digital compression and HDTV.

With regard to evasions, the Commission should construe this provision narrowly given the apparent lack of Congressional guidance specifying particular conduct which might constitute an evasion of the anti buy-through requirements. Finally, the Commission should encourage flexible marketing schemes which will maximize consumer choice as it enforces the rate nondiscrimination clause of the anti buy-through provision.

Respectfully submitted,

TIME WARNER ENTERTAINMENT
COMPANY, L.P.

By: 
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OFF-PREMISES BROADBAND ADDRESSABILITY: A CATV INDUSTRY CHALLENGE

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Abstract - A marketplace need for automating control of broadband CATV signal delivery is described. Past and current efforts to produce equipment meeting this need are outlined, and some concepts for future approaches are suggested. The economic forces at play in the implementation of such a system are described, along with an approach for modeling the operating cash flow needed to offset the required capital investment. The conclusion is drawn that a need for such a delivery technology does exist, and is likely to grow as competitive forces increase the cable industry's need to improve compatibility with consumer electronic equipment, deliver an increasing number of switched video (pay-per-view) services, and control operating expenses. Meeting this need is seen to involve meeting significant technical and economic challenges.

INTRODUCTION

Over the last several years the cable industry has been undergoing an agonizing reappraisal of the role which addressability should play in its operating systems. While there is not yet industry consensus, the outcome of this debate will be a major factor in determining cable's future. On the one hand, some operators are moving aggressively away from addressability, finding refuge in the simple negative and positive trap technology which initially built the pay TV business. Other operators are moving more aggressively into addressability because of their belief in the future of pay-per-view services.

The original dream of addressability encompassed automated delivery of multi-pay and pay-per-view, operating savings from reduced truck rolls, reduced converter losses, and the ability to market more flexibly. In retrospect, we see a number of unanticipated problems. Addressability introduced additional layers of complexity to virtually all operational aspects of our systems, and there were varying degrees of success in coping with this. Some vintage addressable converters were unreliable, wiping out potential operating savings and angering subscribers to boot. While most addressable set-top units being delivered today have achieved acceptable reliability, these problems will be with us for some years in our universe of older converters.

Additionally, the multi-pay environment did not require the number of channels once expected. Three or four services appear to meet the needs of most markets and trapping is often a viable delivery option. Problems with consumer friendliness, which resulted from the introduction of scrambled signals at the same time that "cable-ready" consumer equipment was being introduced in volume, were largely unforeseen, but have growing significance. According to research done by ATC over a large sample, over 52 percent of cable subscribers own cable-ready equipment and over 68 percent have VCR's. As an industry, we have not been particularly successful in addressing the resulting issues.

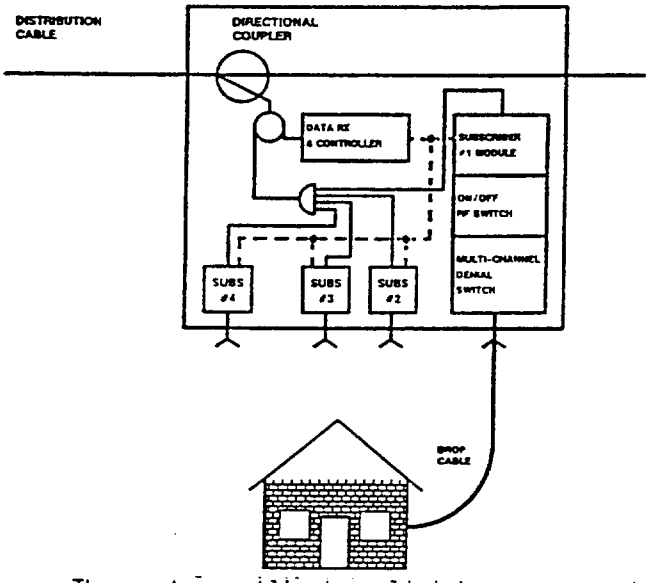
The experience of a number of operators indicates that there is additional revenue available from pay-per-view, although the magnitude remains unclear. In addition, our most likely long-term competitors, who will employ direct broadcast satellites and switched telco delivery systems, may well be capable of pay-per-view delivery to all of their subscribers. Thus, to the extent that pay-per-view offers things that consumers want, our moving away from addressable technology may put us at a competitive disadvantage.

The operating economies which are an unrealized part of addressability's potential are more important than ever. This is true in improving present-day margins, as well as in positioning for future price competition. In addition, skilled labor will continue to become more expensive and increasingly scarce in years to come.

We also need to capitalize on the proliferation of cable-ready equipment, with its potential to decrease the need for capital investment inside the home ATC's research indicates that 52% of cable subscribers have cable-ready TV sets currently. Further, the consumer expects us to be compatible with the equipment he purchases. While traps can satisfy the need for broadband, unscrambled delivery to the home, in the long term it is important that we explore ways to combine this feature with addressability.

The heart of the challenge is the separation of scrambling from addressability, and the provision of unscrambled, broadband signal delivery under addressable control. A generalized approach which would meet these goals is shown in figure 1. This represents a device located outside a subscriber's premises which would allow broadband unscrambled delivery of all services ordered by that subscriber. The device would have the ability to turn "off" or "on", and to intercept premium services not ordered by the subscriber. This would allow a subscriber to use any cable-ready equipment he might own, and to receive all services to which he subscribed at all outlets within the home. Any TV or VCR not having the channel tuning capabilities necessary to receive this service would, of course, need an RF converter. However, subscribers with cable-ready equipment would not need any additional equipment inside their homes. The cable operator would have full control over each subscriber's reception remotely.

FIGURE 1



The system outlined would behave very much like a current CATV system with individual channel traps except that customer connection, disconnection, and changes in authorized services would be fully automated. This would have a number of implications. First, there would be an opportunity to substantially reduce operating costs through the elimination of physical visits to the subscriber's home in order to change to status of his service. This would be further enhanced by an expected increase in drop reliability due to a dramatically reduced need to physically handle drops. Drop cables, once installed, could be permanently secured and waterproofed, removing a major cause of future service calls.

The system would have the positive consumer equipment interface aspects outlined above, avoiding a significant cause of subscriber dissatisfaction in systems that currently use scrambling as a means of signal security. The cable company would reduce the amount of equipment necessary inside the home, which would result in a decrease in related capital and operating expenses as the universe of cable-ready equipment continues to increase.

In addition to reducing operating costs and improving customer satisfaction, the system outlined would also be capable of providing pay-per-view services to any subscriber. Marketing flexibility would be increased with the ability to demonstrate cable's products for any period of time desired.

Finally, such a system begins to set the stage for the future. The ability to authorize "slices" of spectrum leaves open the door to controlling potentially non-standard HDTV signals. In addition, this form of addressability would, in essence, provide distributed video switching, which could, if combined with switching elsewhere in the network, ultimately result in selective delivery of video to individual homes.

TECHNICAL CHALLENGES

While there are a number of conceptual approaches to realizing off-premises broadband addressability, implementing such technology in a practical way poses a number of challenges. Clearly, an outdoor device can be built with the capability of turning a drop off and on under remote control. The control system would, in fact, be very much like that used for addressable descrambling systems today, and PIN diodes or relays could serve to disconnect an unauthorized drop with sufficient signal isolation. Additionally, there are a variety of approaches available to selective delivery of individual channels to the subscriber drop cable. These include fixed frequency and frequency-agile positive and negative traps, as well as various types of fixed and frequency-agile jamming signals to be summed with individual unauthorized channels.

The challenges in realizing a practical off-premises broadband addressable system arise from the need to deliver unimpaired signals on authorized channels, to remove or disrupt video information from unauthorized channels sufficiently to prevent practical use, and to prevent defeat scenarios which would involve signal processing inside the home. In addition, powering a large number of active devices in the CATV system is not a trivial matter. If they were to be powered from the CATV plant, it is likely that a substantial increase in system power supplies would be required, necessitating a significant capital investment in power supplies, in adding to increased on-going power expenses.

An additional concern is the maintenance and reliability implications of adding a large number of active devices to the network in a hostile physical and electrical environment. While this is partially true of addressable set-top converters as well, it should be remembered that a number of years passed before satisfactory

reliability was achieved with those devices. Prior to that time, significant expense and subscriber disruption was caused by converter malfunction and failure. If off-premises broadband addressable devices cannot be produced with very high long-term reliability, it is clear that any operating cost reductions will be more than offset by maintenance costs, and subscriber satisfaction gains created by compatibility with cable-ready equipment will be destroyed by dissatisfaction due to service disruptions.

Thus, the goal of mass-producing an affordable, practical device for selective broadband signal delivery located outside the home, with a high degree of reliability, is a major challenge. This is further exacerbated by the hostile environment in which such a device must be placed, with the hazards of moisture, wide temperature variations, and electrical discontinuities caused by power utility fluctuations and surges. This challenge has, in fact, defeated several attempts in past years to produce such equipment.

PAST APPROACHES

The attraction of off-premises addressability is not new. A system was developed by AMECO in the late 70's which utilized relays along with a data receiver in a line extender housing to produce an off-premises addressable tap. Latching reed relays were used to turn off and on individual subscriber drops, and to switch in and out a single negative trap on each output. The system was field tested, but was never implemented on a large scale, possibly due to the advent of multi-pay services at about that time as well as, it is surmised, concerns about cost-effectiveness.

In the early 80's, an addressable tap was marketed and was installed in a few cable systems by Delta-Benco-Cascade. The system was sold in both an outdoor, four-port addressable tap configuration, and an addressable wall-plate configuration for loop-wired multiple dwelling units. The DBC system used phase modulation of the AC powering waveform to transmit data from each power supply location to each tap or wall plate. This allowed the construction of an exceedingly simple data receiver within each tap, with a more complex RF data receiver located at each power supply receiving addressable instructions from a computer at the headend.

The DBC addressable taps could turn signals on and off, using PIN diode RF switching, as well as control two pay channels, using a negative and a positive trap. The product was ultimately discontinued and all known installations were dismantled, due to reliability problems with both the tap units and the data modulated power supplies. This is a clear illustration of the lack of reliability destroying any possible operating cost savings.

During the early to mid-80's, a variety of off-premises converter systems were developed and tested. These included the DST system developed by ATC and Toshiba, Texscan's TRACS converter system, C-COR's SCAT system, and Times Fiber's Mini-Hub I and II (Mini-Hub I used multi-mode optical fiber for the connection from the addressable converter to the home). While these approaches differed in specifics of powering, design and construction, the essentials of an addressable set-top converter were located outside the home, with only a control head at the television set. Up-stream signals from the control head instructed the external converter as to which channel to tune, and a single channel was delivered downstream to the television. Sometimes provision was made for several control heads and converters to share a single drop, using several channels. The external converter electronics contained a data receiver which received authorization information from the headend. All of these systems were field tested, and some were installed in some quantity in operating cable systems.

The introduction of these systems coincided with an increasing proliferation of cable-ready consumer equipment. These systems shared all the consumer interface drawbacks of addressable descrambling converters, and most lacked any ability to deliver broadband signals to the home for use by cable-ready TV sets and VCR's. In addition, the electronics moved outside the home were the inner-workings of a highly complex RF hetrodyne converter, and most systems had a variety of reliability problems. Consumer interface problems and the failure to realize operating economies proved fatal to these approaches, and all have been, or are being, discontinued from production and removed from service.

Thus, attempts, to date, to accomplish practical off-premises addressability have been defeated by failure to achieve cost-effective operation on a scale which justifies the capital expenditures involved, and, in the case of off-premises converters, to provide sufficient subscriber utility. The lessons which appear to have been learned are that broadband signal delivery from an off-premises device is important, both in terms of consumer interface issues and achieving a practical level of the simplicity, and that reliability is an absolutely critical factor in implementing this technology. Experiences with powering such devices from the cable system clearly involved high costs for additional power supplies, and for the substantial number of kilowatt-hours required. Approaches which used powering of the drop from the home avoided those problems but necessitated accessing the home, an additional source of trouble calls due to subscribers' inadvertently disconnecting power.

CURRENT APPROACHES

There are three basic approaches to off-premises broadband addressability currently available commercially. The first involves "signal interdiction" in an addressable tap at the pole. Variations of this are offered by AM Communications and Scientific Atlanta. In both cases, the pole mounted tap includes a data receiver and a jamming oscillator or oscillators which are frequency agile, and can be selectively

switched onto a subscriber output port. In the case of the AM Communications product, a single oscillator can frequency hop to as many as sixteen channels, while Scientific Atlanta employees four frequency agile oscillators which can cover a larger number of channels. In both systems there is a clear tradeoff between the number of channels which share an oscillator, and the level of security and "signal masking" on unauthorized channels. Both allow a decrease in the number of channels sharing an oscillator to allow better masking of particularly controversial programming. While there are differences in features and costs of between the two systems, both are currently being installed, or will be installed in the near future, in working systems. This will hopefully result in the capture of meaningful data about their reliability and the actual operating savings realized.

A second approach to broadband addressability which is currently being offered has been termed "on-premises addressability" This approach essentially automates positive and negative traps at a location outside each home, as opposed to being located at the pole or equipment pedestal. In these approaches, a data receiver controlling PIN diodes, turns the drop off and on and switches positive and negative traps in and out the circuit. They receive their power from inside the home, and can be located in an environment less hostile than that of pole-mounted equipment. Advantages of this approach include an incremental investment which can be selectively deployed against subscribers most likely to order pay-per-view services, or against some other rational. Drawbacks include the inability to share system costs across more than one subscriber and concerns about physical security.

A third category of addressable broadband addressability is being offered for the multiple dwelling unit environment. These generally are capable only of turning individual drops on and off remotely, and do not address the control of pay services. This technology is relatively simple, with the cost of the data receiver being shared by many subscribers. These units seem to be finding utility in multiple dwelling units with a high degree of subscriber turn-over, especially in resort and university environments.

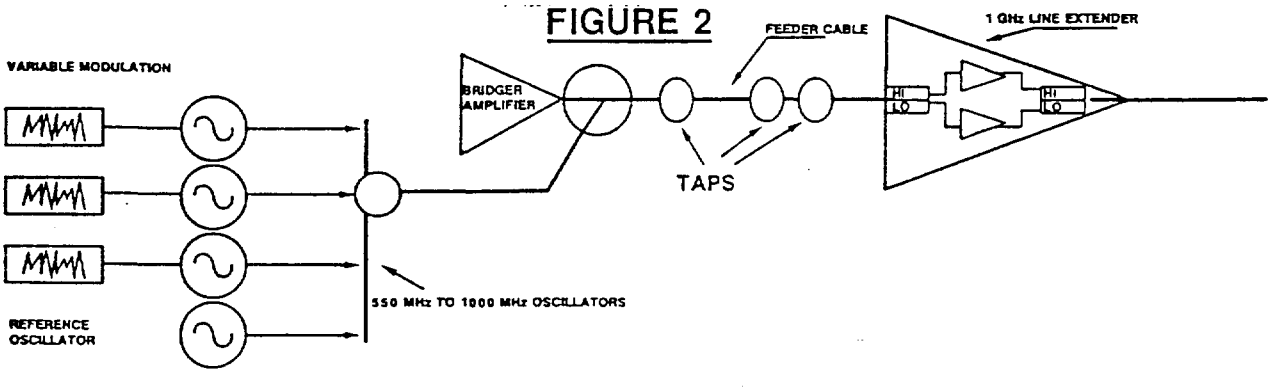
ALTERNATE APPROACHES

In examining other possible approaches to off-premises broadband addressability, the goals are to shed complexity and to share costs, while maintaining the ability to turn off and on individual subscriber drops and to control a reasonable number of individual channels. Figures 2 and 3 show such an approach. In this approach, a number of jamming oscillators, at frequencies well above those of the channels delivered by the CATV system, are located at the bridger amplifier. These are modulated to provide a high degree of video and audio masking to channels with which they are ultimately mixed. Also located at the bridger amplifier location is an unmodulated master oscillator, also well above the frequencies of interest in the system. These signals are combined with the bridger output, and are transported through distribution at high frequency. This requires tap electronics capable of passing frequencies perhaps as high as 1 GHz. It also requires that line extender amplifiers make provision for amplifying these frequencies. Because noise and distortion are not of great concern with regard to these signals, a separate amplifier stage for the high frequency jamming signals could be used within line extenders, in addition to a high-performance broadband amplifier for the CATV signal spectrum.

Figure 3 shows the inner workings of the tap. Switched notch filters are used to turn off and on individual jamming oscillators. The master oscillator frequency is recovered and applied to a mixer, hetrodyning the jamming oscillators down to their final frequencies within the CATV band. The summing of the switched jamming frequencies with the CATV spectrum results in a broadband signal to the subscriber with unauthorized channels obliterated. Notch filtering of jamming signals could also be performed after down conversion. This approach would allow one oscillator per channel, since the cost of oscillators would be shared across many subscribers.

Figure 4 shows another possible arrangement, using a jamming oscillator at 74 MHz, between channel 4 and channel 5, located at the headend. Within the tap, this jamming frequency would be divided by two and applied to a comb generator which would generate multiples of 37 MHz. This would result in interfering carrier frequencies

FIGURE 2



at 111 MHZ, 148 MHz, 185 MHz, 222 MHz, etc. These jamming frequencies could then be selectively filtered before being combined with the CATV signals to each subscriber. Thus, a degree of system simplification could be achieved at the cost some inflexibility regarding the channels used for premium services.

FIGURE 3

TAP DIAGRAM

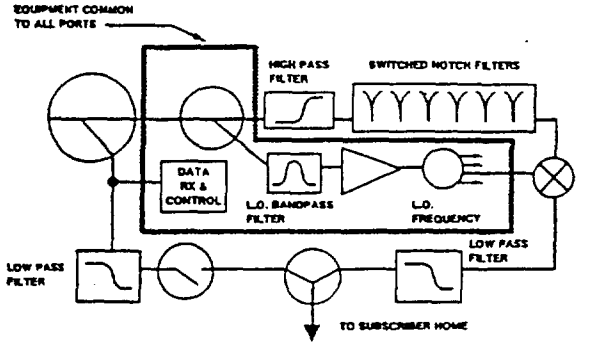
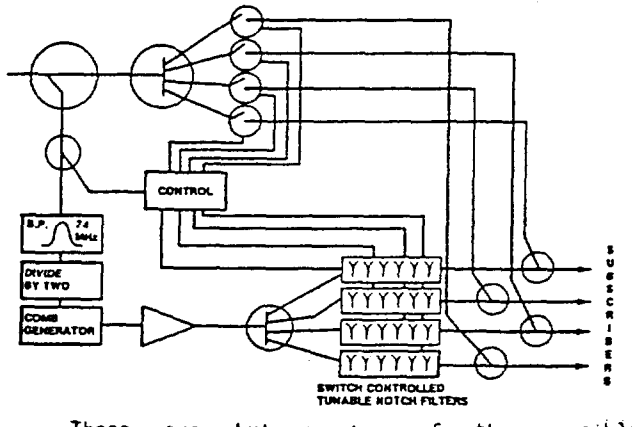


FIGURE 4



These are but a few of the possible architectures for use in an off-premises broadband addressable signal delivery system. Since such systems incur significant penalty for both initial capital expense and complexity, there is a premium to be obtained in simplifying the system and spreading the cost of expensive components or subsystems across a number of subscribers.

ECONOMICS

There are a number of positive and negative forces at work when we examine the cost-effectiveness of off-premises broadband addressability. Economic modeling of the equilibrium between these forces can become highly complex, as there are many variables. While only field experience will resolve some of these issues, it is worth examining key factors in building an economic model.

Reduction Of Subscriber Visits

This item has potential to be a major justification for the installation of off-premises addressability. It is assumed that an off-premises broadband addressable system would eliminate the need for most visits to the home. Once an installation had been performed, future disconnections, reconnections, and changes in level of service would be automated. The cost of rolling a truck to a subscriber's home is estimated to be between 20 and 30 dollars per visit. Basic churn in most cable systems is between 1 and 3 per cent of subscribers per month. It is may be assumed that installation of outlets in additional or different rooms in a subscriber's home would be billed at cost and would therefore, be cash flow neutral.

Universal Pay-Per-View

One obstacle to the growth of pay-per-view has been the limited number of homes in most systems which have addressable converter/descramblers. In systems which use set-top addressability, it can be argued that most potential pay-per-view subscribers also subscribe to scrambled pay services, but that hypothesis is untested. Additionally, it is clear that major pay-per-view events, such as boxing and wrestling matches, with their substantial revenue potential, could sell to a wider audience if a delivery mechanism were in place. When compared with a trapped system, off-premises broadband addressability has significant revenue potential in terms of pay-per-view.

There is no consensus in the cable industry about the size of this potential revenue, but it is an important factor to be examined in modeling off-premises addressability.

Consumer-Friendly Broadband Delivery

Systems which employ addressable scrambling, as opposed to trapping, in order to control selective delivery of pay television or pay-per-view product provide a fair degree of frustration to that majority of their subscribers which have cable-ready consumer electronics equipment. If there is any benefit to be gained from improved subscriber satisfaction, off-premises broadband addressability should capture it. Such a benefit should take two forms. First is an economic advantage, in the form of improved retention and, therefore, penetration. This is a difficult effect to isolate from other factors in subscriber penetration, and is a potentially large but difficult factor to use in economic modeling. The second advantage of improved utility of consumer electronics is strategic. With a variety of alternative video delivery systems on the horizon, cable's strategic ends are not well served by providing a source of subscriber frustration.

Reduced Set-Top Converter Capital Investment

When an off-premises broadband addressable system is compared with a set-top addressable descrambling system, the off-premises system has a clear advantage in its ability to benefit from

cable-ready consumer equipment in the reduction of the set-top converters needed in the system. Since set-top addressability requires a device in the home regardless of the kind of television set the subscriber owns, and since the number of cable-ready TV's and VCR's is steadily increasing, a system using off-premises addressability should show a decreased need in future years for set-top converters. In addition to gradually reduced set-top capital requirements, elimination of converters from an increasing number of homes decreases the need for service call, and converter delivery and pick up. Additionally, this would result in fewer unretrieved converters.

High Capital Cost

Off-premises broadband addressable signal delivery systems currently available have an installed capital cost between $75 and $125 per subscriber. This represents a very significant incremental investment, and we can reasonably expect to make it only if offset by sufficient benefit.

Powering

Powering from the home involves no incremental additional power cost, but does involve accessing in the home for the installation and maintenance of a low voltage power supply and power inserter. This is somewhat at odds with the goal of using off-premises addressability to reduce operating costs and subscriber contact. Such a scheme also increases the capitalized investment necessary to implement an addressable system. Powering from the plant has the potential of requiring many additional power supplies. This item is highly dependent upon power consumption of the addressable devices, and provides a powerful incentive for developers to minimize power requirements.

Maintenance

Even though off-premises broadband addressable taps are conceptually quite simple, the fact that they would be deployed in very large numbers has potential to have enormous impact on system maintenance economics. In a sample design of a 3,000 mile plant, 105,000 active addressable taps were found to be required. Thus, there is substantial economic impact from anything but exceedingly high device reliability. In addition, any lack of reliability will result in a loss of subscriber satisfaction.

Economic Modeling - An Approach

A practical means of developing a feel for the economic trade offs involved in installing an off-premises broadband addressable system can be derived from examining the annual incremental cash flow requirements necessary to provide a reasonable internal rate of return (IRR) against incremental capital required for the installation of the system. In the following example, the assumption was made that the existing system used traps for signal security, and was in need of a major plant upgrade, involving splicing in new system taps throughout. Thus, no incremental labor was included for the installation of addressable taps. Figure 5 shows basic statistics regarding the system sampled.

FIGURE 5

SAMPLE CATV SYSTEM ($ X 1000)

280 MILES OF PLANT (TRAPPED FOR SECURITY)
21,550 PASSINGS
16,500 BASIC SUBSCRIBERS
10,500 PAY UNITS

REVENUE	
TOTAL BASIC	$3,183
TOTAL PAY	1,197
MISCELLANEOUS REVENUE	227
TOTAL REVENUE	4,607
COST OF SALES (PROGRAM COST)	735
OPERATING EXPENSES	1,615
TOTAL CABLE CASH FLOW	2,257

The following assumptions were used for the modeled off-premises addressable system:

The subscriber unit would be made up of two pieces. The housing and back plane would have the potential to serve for subscribers, and would cost $150. Additionally, one subscriber module would need to be added for each active customer served. These modules would cost $50 each. It was also assumed that the unit could be driven by standard tap input levels, so a system would require the same number of active as a non-addressable system. It is further assumed that this system would be powered from the home, at an installed cost of $10 per home.

It is also assumed that the increased maintenance cost from the installation of over 7,000 additional, but highly reliable, active devices is offset by the service call savings resulting from decreased drop handling and the ability to permanently weatherproof drops.

Over time, with churn, it is assumed that 88% of homes passed would be installed, requiring capital investment in off-premises modules.

Although each tap is capable of serving four homes, it is assumed that the design is 70% efficient; that is that 30% of the tap outputs (4 per device) will be unused, on average. This means that the 21,550 passings will require 7,395 devices to be installed.

It can be seen in the highly simplified example in Figure 6 that the installation of off-